Technology Opportunity
Glenn Research Center • Cleveland • Ohio
Technology Transfer & Partnership Office
TOP3–00171

High-Speed Electromechanical Shutter for Imaging Spectrometers

Technology

The high-speed electromechanical shutter for imaging spectrometers was developed to meet the needs of combustion research for the Ultra-Efficient Engine Technology Program Office. It provides a method of improving the quality of the data gathered with Raman spectroscopy for research of combustion physics. The present technology will be advantageous in reducing background noise in all pulsed laser spectroscopy applications. The novelty of the invention is that it is electronically controlled.

Benefits

- Use of electronically controlled Mechanical Shutter Mechanisms to achieve gate times as short as 15 microseconds at a repetition rate adjustable from 0 to 6kHz that can be synchronized with external events with 1.5μs jitter
- Modest upgrades in shutter system components will easily yield two microsecond gate times for .25 mm apertures geared together electronically, not mechanically, using phase-lock solid-state electronics
- Absence of mechanical contacts results in no wear or backlash
- Higher frequency stability, lower timing phase jitter
- Repetition rate of 0 to 6 kHz that is electronically selectable on demand
- Repetition rate designed and suitable for pulsed lasers such as Nd: YAG or excimer lasers, which have repetition rates in this range
- Uses non-intensified, back-side-illuminated charge-coupled device (CCD)
- Shutter is easy to align and use
- Higher level of phase stability and permits high resolution adjustment of the relative phase angle between the two chopper blades
- Use of conventional chopper motors and slower speeds permits the routine use of this shutter system for gating spectrometers and other photonic devices

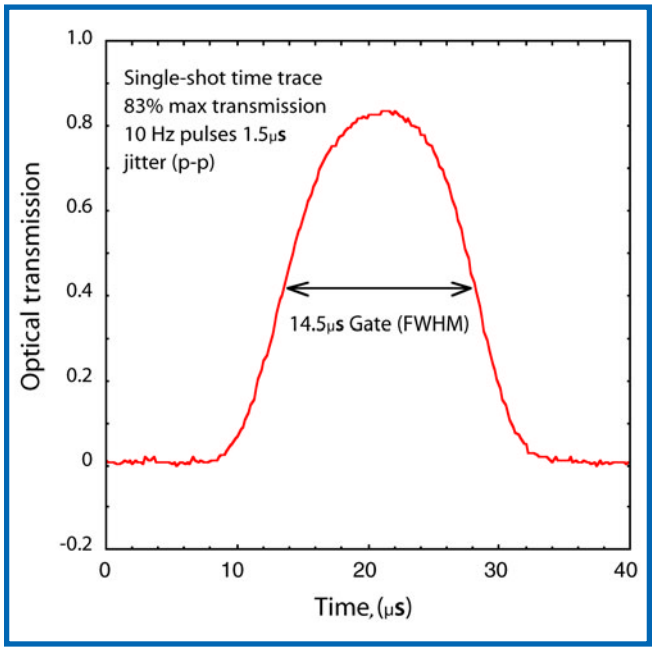

Figure 1.—Single-pulse optical transmission for shutter with 0.4-by x 12.0-mm aperture.

Commercial Applications

- Measurement of ozone and sulfur dioxide in the troposphere
- Monitoring of plasma etch reactors
- Measurment of auroral emissions against the background of the daylight sky
- Measurment of soot in and near flames
- Airborne imaging for crop analysis
- Multipoint detection and quantification of analyses in process environments
- Detection of contaminates on industrial surfaces via Raman scattering
- Non-invasive measurement of oxygen in biological tissues
- Rapid DNA sequencing
- Blood and body fluid analysis
- Quality control in manufacturing ceramic tile, leather, fur, paper, and food products, etc.

Technology Description

This technology uses a high-speed electromechanical shutter system that does not rely on gearing or other stability-inhibiting mechanisms. Thus, problems in jitter and high-speed stability that occur with current shutter technologies are eliminated.

This unique design provides gate time on the order of microseconds, while simultaneously allowing the light to pass through only ten times per second—a time appropriate for the pulse rate of the laser and the response time for the CCD detector. The gate width and pulse rate can be adjusted.

The technology is a an improvement in the electromechanical method and provides high-frequency stability, no wear, and no backlash.

Options for Commercialization

One of NASA's missions is to commercialize its technology. Additional developments might be needed to optimize and further refine the properties for specific applications. If your company is interested in licensing this technology or you desire additional information, please contact us.

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References

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Key Words

High speed shutter

High speed imaging

Raman spectroscopy

Laser spectroscopy